Chpt 7
P 215 Q 2 a, c, e, f
3 a, c, e
4 a - f
219 Q 2
228 Q, 3
233 Q 1, 5
~~235 Q, 10, 14~~
236 Q 26, 27
237 Q 33, 35, 37.

Chpt 7 Test starts Here!

Chpt 7 : Language of Chemistry

CO_2 } formula itself means 1 molecule or 1 mole.
H_2O } (6.022×10^{23} moles)

subscript → indicates #'s of constituent atoms
ex → 2 H-atoms & 1 O-atom

* once correct subscripts are made they CAN NOT be changed! *
[same w/ superscript]

- if one mole of H_2O ⇒ 2 moles of H-atoms.

Making Ionic compounds

Steps

ex. Ca^{2+} Cl^-
→ cations are always 1st
· step back... ionic compound → NaCl → Na^+ Cl^-

→ net charge = 0 always!!

ex. (cont) $CaCl_2$ (need 2 chlorides to balance of out 2+ charge of calcium)

ex.	Br^-	CO_3^{2-}
Mg^{2+}	$MgBr_2$	$MgCO_3$
Al^{3+}	$AlBr_3$	$Al_2(CO_3)_3$
NH_4^+	NH_4Br	$(NH_4)_2CO_3$

ex $Al^{3+} + S^{2-} \rightarrow Al_2S_3$

criss-cross method : Al^{3+} S^{2-} $\square$ $\square$ --> Al_2S_3

· if $Mg_2(CO_3)_2$ → not reduced! → also reduce subscripts.

01-25-06

	Br^-	SO_4^{2-}	ClO_3^-
K^+	KBr	K_2SO_4	$KClO_3$
Ba^{2+}	$BaBr_2$	$BaSO_4$	$Ba(ClO_3)_2$
NH_4^+	NH_4Br	$(NH_4)_2SO_4$	NH_4ClO_3

Naming ionic compounds (the stock system) * DO NOT use prefixes for ionic compounds!!

1. Name the cation
2. Name the anion

ex. $NaCl$ → sodium chloride

ex. $NaOH$ → sodium hydroxide.

ex KBr → Potassium Bromide

ex. $BaBr_2$ → Barium Bromine

ex. NH_4Br → Ammonium bromide

ex. $Ba(ClO_3)_2$ → Barium chlorate.

* ate ion → higher charge.

* ic ion → higher charge.

poly valent ions - more than 1 charge.

ex $FeCl_3$ → Iron(III) chloride
$FeCl_2$ → Iron(II) chloride
stock system → use Roman numerals

• old system. (use latin names)

ex $FeCl_3$ → Ferric chloride

$FeCl_2$ → Ferrous chloride

* for naming ionic compounds : • metal + nonmetal
• metal + polyatomic

01-27-06

Naming Molecular Compounds → 2 nonmetals.

CO → carbon monoxide

CO_2 → carbon dioxide

As_2O_5 → diarsenic pentoxide

• Rules of Naming

Step 1 : name the 1st element

(if more than one ⇒ give it a numeric prefix)

Step 2 : Name the 2nd element w/ numeric prefix & -ide suffix :

ex. N_2O_5 → dinitrogen pentoxide

ex. SiF_4 → silicon tetrafluoride

ex. XeF_6 → Xenon hexafluoride.

but before ...

Numeric Prefixes [drop vowels when they feel like it...]

• 1 → mon(o) • 2 → di • 3 → tri • 4 → tetra • 5 → pent(a)

• 6 → hex(a) • 7 → hepta • 8 → oct(a) • 9 → non(a) • 10 → dec(a).

Naming Acids : all start w/ Hydrogen.

• Types of acids → 1) Binary (H w/ another element)
→ 2) oxyacids (H w/ a polyatomic oxyanion)

• Binary Acid :

ex HCl → hydrochloric Acid.

→ hydro (prefix) + element name + -ic suffix = an acid.

ex HF → hydrofluoric acid

ex HBr → hydrobromic acid

• oxyacids : ex HNO_3 → Nitric acid

ex H_2SO_4 → Sulfuric acid.

→ take anion name

- if it ends in -ate → change suffix to -ic } acid
- if it ends in -ite → change suffix to -ous }

ex. H_2CrO_4 → Chromic Acid

ex. HNO_2 → Nitrous Acid

01-31-06

Mol concept   1 mol = 6.022×10^{23} "things"

- for elements ... 1 mol$_{\text{element}}$ = 6.022×10^{23} atoms

- for compounds ... opt. a) 1 mole$_{\text{molecular (covalent bonds)}}$ = 6.022×10^{23} molecule (molec.)

  opt b) 1 mole$_{\text{ionic comp.}}$ = 6.022×10^{23} formula units (fu)

- mol. concept of w/ compounds.

$$\text{mass (g.)} \underset{\times \frac{1\text{ mole}}{x\text{ g.}}}{\overset{\times \frac{x\text{ g}}{1\text{ mol.}}}{\rightleftarrows}} \text{mole} \longrightarrow \begin{cases} \text{atoms (element)} \\ \text{molec. (cov. comp)} \\ \text{formula unit (ionic comp.)} \end{cases}$$

for elements!
ex. mass → mole.

$11.5 \text{ g Na} \times \dfrac{1 \text{ mol}}{23.0 \text{ g Na}} = 0.500 \text{ mol Na}$

atomic mass expressed in g/mole ⟹ molar mass

for compounds
ex. 6.7 g NaCl = ______ mol of NaCl.

$6.7 \text{ g NaCl} \times \dfrac{1 \text{ mol}}{\text{\_\_\_\_ g NaCl}}$ ← add their masses together!

- molar mass (for comp.) = the total mass of each atom. ~~present of~~

02-02-06

• 2.10 g $KMnO_4$ → find: ___ fu $KMnO_4$

___ atoms of O

(39) + (55) + (4)(16) → 158 ___ # of p. from O.

• 2.10 g_{KMnO_4} • oops! $\frac{158\ g_{KMnO_4}}{1\ mol_{KMnO_4}}$ $\frac{6.022\times10^{23}\ fu\ KMnO_4}{1\ mol\ KMnO_4}$ = $\boxed{8.00\times10^{21}}$ fu_{KMnO_4}

• atoms of O... Plan A 2.10 g_{KMnO_4} • $\frac{1\ mol_{KMnO_4}}{158\ g_{KMnO_4}}$ • $\frac{4\ mol\ O}{1\ mol_{KMnO_4}}$ • $\frac{6.022\times10^{23}\ atom\ O}{1\ mol\ O}$

= $\boxed{3.20\times10^{23}\ atoms_O}$

ex. H_2O

2 atoms 1 atom

1.2×10^{24} atom H 6.022×10^{23} atoms O

2 mol. 1 mol.

Plan B $8.00\times10^{21}\ fu_{KMnO_4}$ • $\frac{4\ atoms\ O}{1\ fu_{KMnO_4}}$ = $\boxed{3.20\times10^{23}\ atoms_O}$

• # of p. from O...

- each atom of O → 8 protons...

$3.20\times10^{23}\ atoms_O$ • $\frac{8\ p_O}{1\ atom_O}$ = $\boxed{2.56\times10^{23}\ p.}$

02-03-06

Percent composition : $\frac{\text{total mass of element in compound}}{\text{total mass of the compound}} \cdot 100\%$

ex. H_2O → assumption $\%H = 66\frac{2}{3}\%$, $\%O = 33\frac{1}{3}\%$ } wrong!

└→ by MASS !

$\% = \frac{\text{mass element in comp}}{\text{mass comp}} \times 100\%$

ex H_2O → $\%O \rightarrow \frac{16\ \frac{g}{mol}}{18\ \frac{g}{mol}} \cdot 100\% = \boxed{88.\bar{9}\ \%\ O}$

→ $\%H \rightarrow 100\% - 88.\bar{9}\% = \boxed{11.\bar{1}\ \%\ H}$

• How many grams of O are in 7.20 g of sulfuric Acid ?

(H_2SO_4) ⇒ molar mass : $98\ \frac{g}{mol}$.

molar mass of O → $64\ \frac{g}{mol}$.

$7.20\ g_{H_2SO_4}$

$\%O = \frac{64\ \frac{g}{mol}}{98\ \frac{g}{mol}} \cdot 100\% = 65.3\%\ O$

• $65.3\%\ O = 0.653$

$0.653\ \frac{g\ O}{g\ H_2SO_4} \cdot 7.20\ \cancel{g_{H_2SO_4}} = \boxed{4.70\ g\ O}$

– harder way to solve problem --> go through the mole.

Lab on composition of Hydrates.

ex. $\underbrace{CuSO_4 \cdot XH_2O}$ [blue] $\xrightarrow[\Delta]{(heat)}$ $\underbrace{CuSO_4 + H_2O\uparrow}$ [white]

water is bonded to compound ⇒ makes it more stable.

└→ hydrate compound

anhydrous compound.

ex BF_3 → readily reacts w/ water.

– compare two masses --> to find value of "x" in formula

02 - 08 - 06

<u>Empirical formulas</u> & <u>molecular formulas</u>

- <u>empirical formula</u> → the simplest (smallest whole # ratios) [most reduced] formula possible

ex $\underbrace{NaCl, MgSO_4, CaCl_2}_{\text{all ionic compounds}}$, or $\underbrace{CH_2O}_{\text{molecular compound}}$

– all ionic compounds have empirical formulas.

- <u>molecular formula</u> – whole # multiple of the empirical formula based on molar mass.

ex $C_6H_{12}O_6$ ← extremely different!

[it's empirical formula is CH_2O]

– molar mass of $CH_2O = 30\ \frac{g}{mol}$

– molar mass of $C_6H_{12}O_6 = (6)30 = 180\ \frac{g}{mol}$

<u>EX. 1</u>: 32.3 % Na 22.65 % S 44.99 % O. --> find empirical formula.

* law of definite composition --> same ratios of % composition no matter the source or size of a sample.

↗ can use any #, but picking 100 only makes it easier.

<u>Step 1</u>: assume 100 g. of compound --> what's the mass of each element present?

32.3 g Na , 22.65 g S , 44.99 g O.

<u>Step 2</u>: convert to moles.

- $\frac{32.3\ g\ Na}{23\ \frac{g\ Na}{mol\ Na}} = 1.41\ mol\ Na$

- $\frac{22.65\ g\ S}{32\ \frac{g\ S}{1\ mol\ S}} = 0.709\ mol\ S$

- $\frac{44.99\ g\ O}{16\ \frac{g\ O}{mol\ O}} = 2.81\ mol\ O.$ ⟹ $Na_{1.41}S_{0.709}O_{2.81}$ not in whole #'s!

<u>Step 3</u>: divide by the lowest # of moles present.

- $\frac{1.41\ mol\ Na}{0.709} = 1.99\ mol\ Na \Rightarrow 2$ - $\frac{0.709\ mol\ S}{0.709} = 1\ mol\ S$

- $\frac{2.81\ mol\ O}{0.709} = 3.96\ mol\ O. \Rightarrow 4$

⟹ $\boxed{Na_2SO_4}$

02-08-06 Empirical formulas & Molecular formulas (cont).

EX. 2 : compound → 34.0 g/mol ; 0.44 g H & 6.92 g O --> what's the molecular formula?

Step 1 → already given the grams.

Step 2: convert to moles.

$$\frac{0.44\ g\ H}{\frac{1\ g\ H}{mol\ H}} \qquad \frac{6.92\ g\ O}{\frac{16\ g\ O}{mol\ O}}$$

$$= \frac{0.44\ mol\ H}{0.44} \qquad = \frac{0.43\ mol\ O}{0.44}$$

$$= 1\ mol\ H \qquad = 1\ mol\ O.$$

⇒ empirical formula → HO

→ find molecular - given molar mass = $34.0\ \frac{g}{mol}$

- molar mass of → $17\ \frac{g}{mol}$ ⇒ $\frac{34.0\ \frac{g}{mol}}{17.0\ \frac{g}{mol}} = \boxed{2}$

⇒ $\boxed{H_2O_2}$

• trick for step 3 → is 1.5 for moles --> double everything!